

APPENDIX

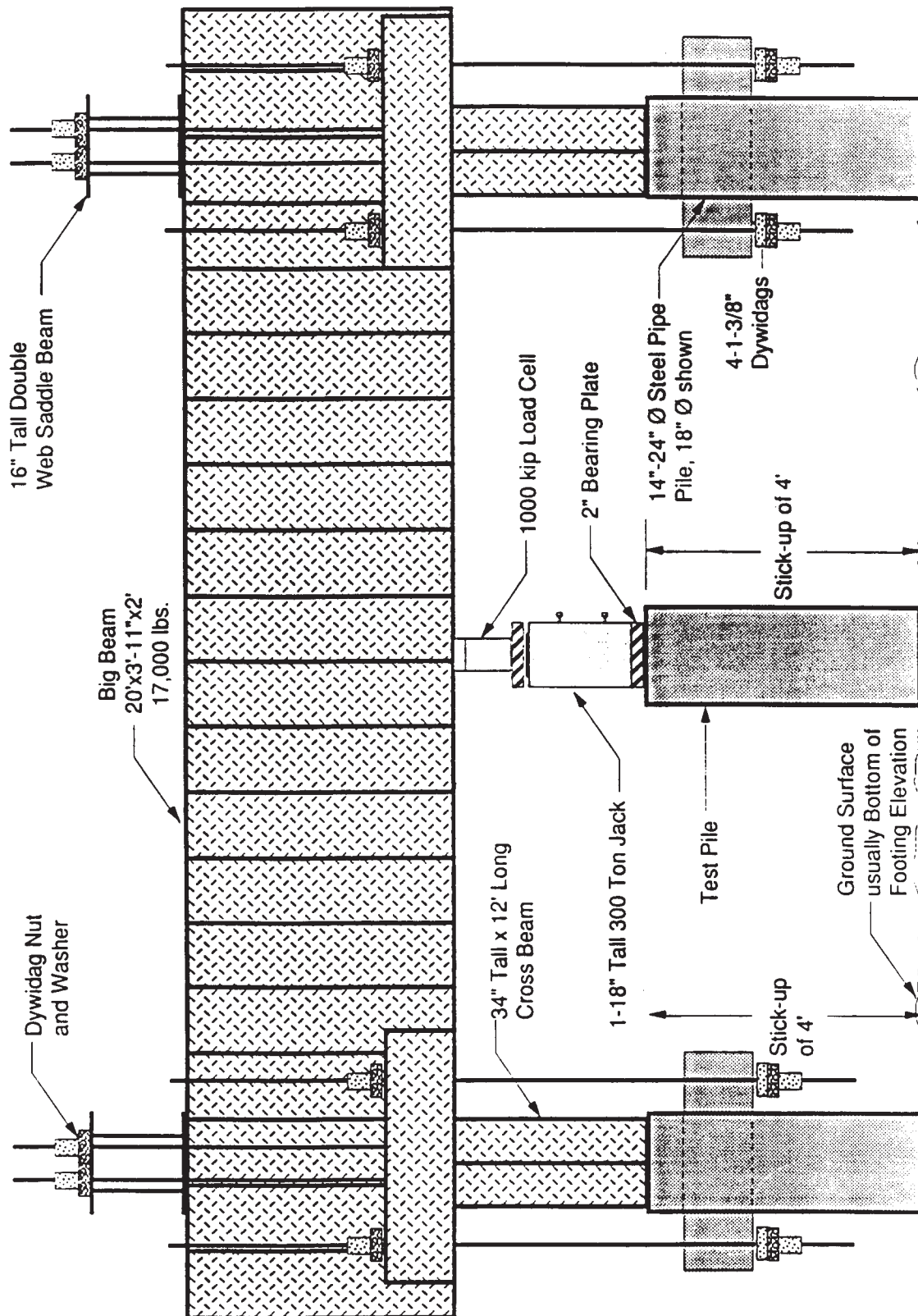
F

**Static Pile Load
Testing and Dynamic
Monitoring**

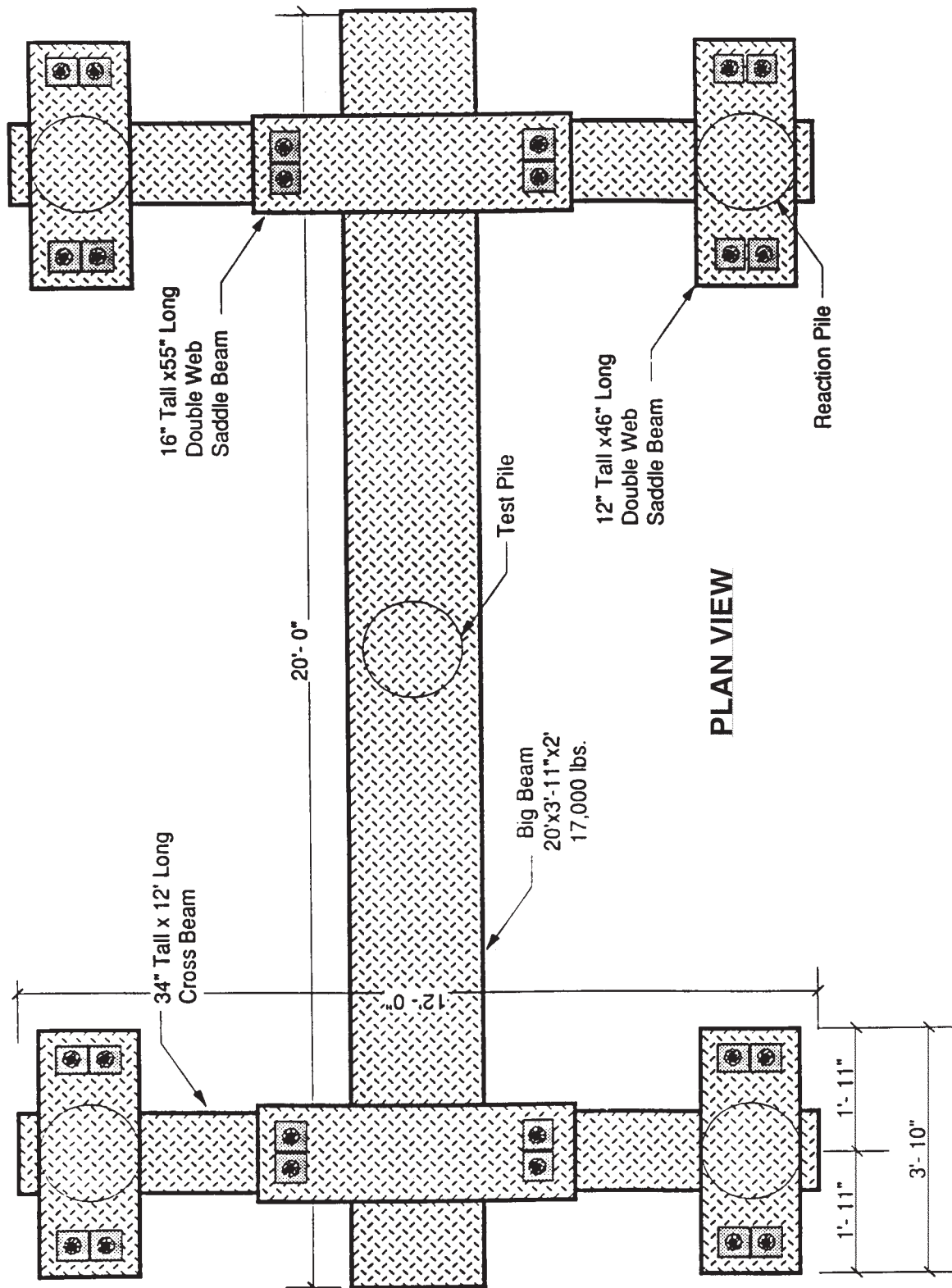
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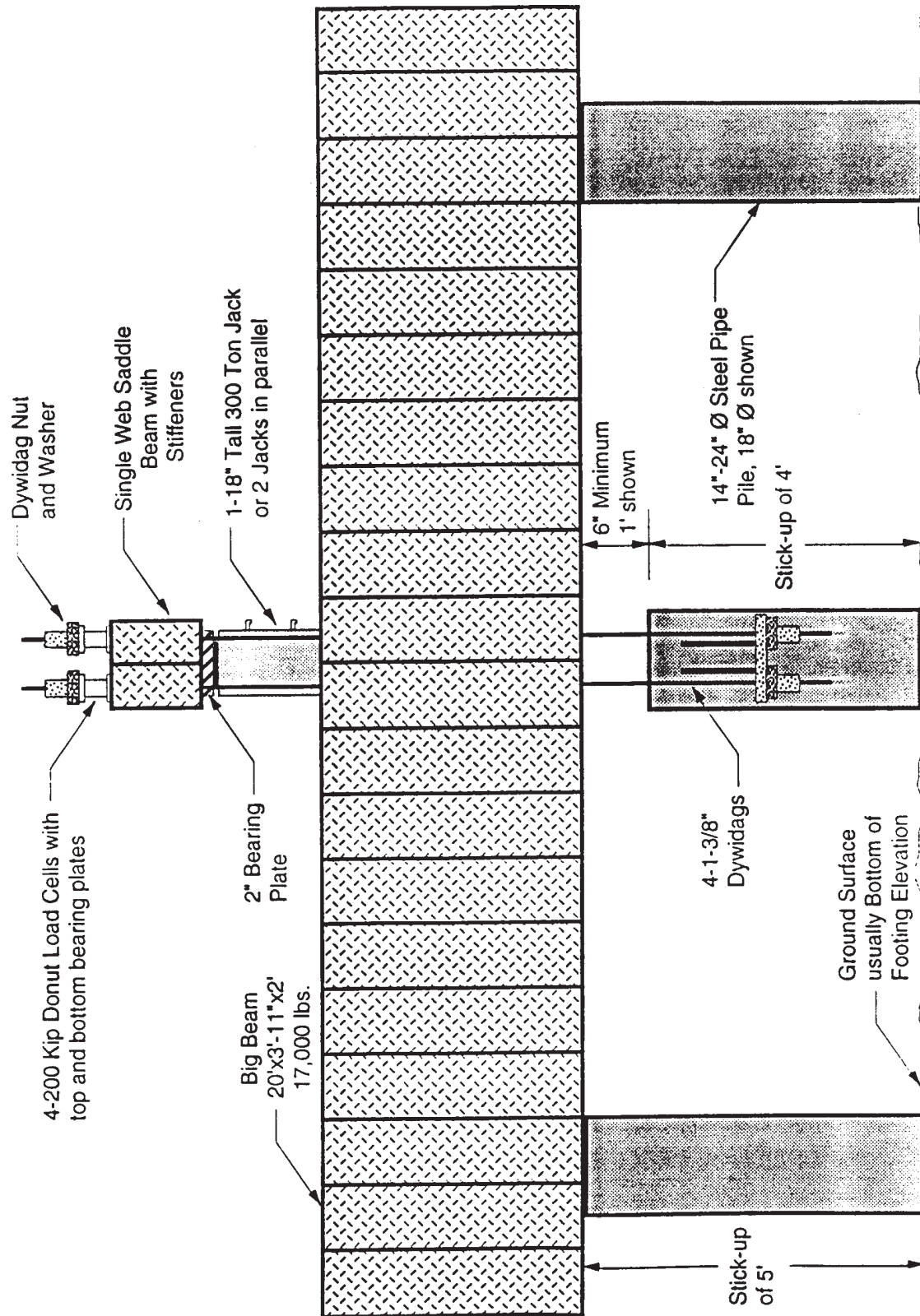
5 Pile Group, Compression Test, Steel Piles



5 Pile Group, Compression Test, Steel Piles



3 Pile Group, Tensile Test, Steel Piles



State of California

Business, Transportation and Housing Agency **M e m o r a n d u m**

To : MR. A. P. BEZZONE, Chief
Office of Structure Construction

Attention MR. AMER BATA

Date : September 13, 1993

File No. : 07-Ven-23-PM 23.3/24.2
07-067043
Santa Clara River Bridge
Br. No. 52-118

From : DEPARTMENT OF TRANSPORTATION
Division of New Technology, Materials and Research
Office of Geotechnical Engineering

Subject Static Tensile and Compressive Pile Load Test Results; Pier 11.

A static tensile and static compressive pile load test has been completed at Pier 11 of the Santa Clara River Bridge, Bridge Number 52-118. Test results were transmitted verbally to Amer Bata, the Structures Representative, on August 25, 1993. This memo will serve to transmit data from the load tests and commentary on the performance of the tested piles. Attached you will find a copy of the vicinity map, general plan, foundation plan, footing details, load test layouts, plots of test pile displacement versus applied load, and relevant Log of Test Borings.

Pile Installation

Pier 11 is located at Station 152+22 on the center line of the Santa Clara River Bridge, Route 23, see Attachments A, B, and C. Five HP 12x74, Class 70, Steel H-Piles were driven on August 9, 1993 with a Delmag D30-32 diesel hammer (maximum energy is 73.7 kip-feet with a ram weight of 6.6 kips). The blow count for the final foot of driving was 31 blows per foot, with a stroke of 8.0 feet. All four reaction piles (No. 396, 399, 413, and 416) were driven to a specified tip elevation of 355.8 feet. The test pile 406 was driven to a tip elevation of 356.1. Test pile 406 had a stick-up above ground of 4.0 feet for a total length of 39 feet, and a length of penetration of 35 feet, measured from the bottom of footing elevation, see Attachments D, and F. The bottom of footing elevation is 391.5 feet. There was no predrilling below bottom of footing elevation. The "Driving Records" are shown in Attachment E. Based on the ENR formula and the final blow count of 31 BPF with a stroke of 8.0 feet, the allowable compressive load for test pile 406 is 220 kips.

Subsurface Conditions

Rotary boring B-2 is 95 feet south of Pier 11 and is the boring nearest Pier 11. From the attached Log-of-Test-Borings dated February 1992, it can be seen that the piles were driven through very dense sand with cobbles with SPT blow counts greater than 70 BPF from the bottom footing at elevation 391.5 feet to elevation

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383 feet. From elevation 383 feet to 373 feet the soil is very hard clay and sandy clay. From elevation 373 feet to elevation 356 feet, the piles were driven into very dense gravelly sands. The groundwater table was measured in December, 1991, at elevation 398 feet at this boring.

Static Compressive Load Test

The compression test was performed on pile 406 on August 24, 1993, fifteen days after installation. The pile load test group consisted of four anchor or reaction piles and one test pile. See Attachment F for the "Pile Load Test Layout." Twenty-kip load increments were applied to the test pile in five minute load durations to a load of 140 kips, the design load. This load was then cycled down to zero, and then back up to 140 kips in one minute load durations. The pile was then loaded to 280 kips, double the design load, in twenty-kip load increments and five minute load durations. Again the pile was cycled to zero and back up to 280 kips in one-minute load durations. The pile was then loaded to 520 kips, triple the design load, in twenty-kip load increments and five minute load durations. Again the pile was cycled to zero and back up to 520 kips in one-minute load durations. Twenty-kip load increments and five minute load durations were used to increase the compressive load on the pile until pile plunging occurred. A maximum of 600 kips was applied to the pile at which no further load could be applied due to continuous jacking.

After the pile plunged, the pile was loaded in 150 kip increments and one minute load durations until plunging occurred again. The maximum load achieved on this final cycle was 570 kips. A plot of the load versus displacement for the test pile is shown in Attachment G.

Static Tensile Load Test

The tension test was performed on pile 406 on August 25, 1993, sixteen days after installation. The same pile load test group used in the compression test was used in this tension test, including the same reaction piles and test pile. Twenty-kip load increments were applied to the test pile in five minute load durations to a load of 70 kips. This load was then cycled down to zero, and then back up to 70 kips in one minute load durations. The pile was then loaded to 140 kips in twenty-kip load increments and five minute load durations. Again the pile was cycled to zero and back up to 140 kips in one-minute load durations. Twenty-kip load increments and five minute load durations were again used to increase the tensile load on the pile until pile pull-out occurred. A maximum of 240 kips was applied to the pile in tension at which no further load could be applied due to continuous jacking.

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After the pile plunged, the pile was loaded in 60 kip increments and one minute load durations until plunging occurred again. The maximum load achieved on this final cycle was 240 kips. A plot of the load versus displacement for the test pile is shown in Attachment H.

Interpretation of Load Test Data

The maximum load applied to pile 406 in compression was 600 kips, and the displacement at this load was 1.244 inches. The compressive capacity of the test pile is 480 kips based on Caltrans half-inch failure criterion, and 520 kips based on Davisson's failure criterion. The permanent displacement of pile 406 was 0.79 inches after the first compression cycle to plunge the pile. The maximum load applied to pile 406 in tension was 240 kips, and the displacement at this load was 1.322 inches. The tensile capacity of the test pile is 190 kips based on Caltrans half-inch failure criterion. The permanent displacement of pile 406 was 1.123 inches after the tension test.

Conclusions

The capacity of compression test pile 406 is 480 kips. It is our understanding that the design ultimate compressive requirement for Pier 11 is 280 kips. As such the tested pile meets the compressive pile capacity requirements for this bent. The capacity of tension test pile 406 is 190 kips. It is our understanding that the design ultimate tensile requirement for Pier 11 is 140 kips. As such the tested pile meets the tensile pile capacity requirements for this bent. These two piles were tested in compression and tension, 15 and 16 days after driving, respectively, no additional pile capacity due to pile set-up is expected over time.

For a DelMag D30-32, a blow count for the final foot of driving of 31 BPF, and an 8.0 foot stroke, the ENR formula predicts an allowable load of 220 kips. Based on the results of the static compression load test, however, the allowable load for this pile can be considered to be 240 kips (measured ultimate load divided by 2). Therefore, the ENR formula appears to provide a reasonable estimate of pile capacity for the tested pile and this geology.

These two tests cover the control area from Pier 11 to Abutment 13. Since the tested pile sustained loads above those required, it is recommended that this control area be released for production piles.

State of California

Business, Transportation and Housing Agency

M e m o r a n d u m

To : MR. A. P. BEZZONE, Chief
Office of Structure Construction

Date : October 14, 1992

Attention MR. WES JOHNSON

File No. : 07-LA-105/405
07-060283
NW Conn. Tunnel
Br. No. 53-2437

From : DEPARTMENT OF TRANSPORTATION
Division of New Technology, Materials and Research

Subject Dynamic Pile Test

A dynamic pile test using the Pile Driving Analyzer (PDA) was performed on October 6 and 7, 1992, at the left footing, Station 42+80, of the North West Connector Tunnel. The 24 foot, 14"x14" Class 100 prestressed concrete pile #44A was driven with a DelMag 30-32 hammer. The test pile was predrilled 10 feet with a 14" diameter auger, as were other piles within 50 feet, due to hard driving. As shown on the attached Log of Test Borings the test pile was driven through stiff sandy and clayey silt, and was founded in dense fine sand at specified tip elevation 15.0 feet. The test pile was monitored during initial driving between a penetration of 5 feet and 19 feet. At 19 feet of penetration a compressive capacity of approximately 280 kips was indicated. The pile was not monitored between 19 feet and 23 feet of penetration. The pile was left to set-up for one day and then monitored during the restrike to final penetration of 24 feet. A DelMag 36-32 was used for the restrike.

The one foot restrike indicated the compressive capacity increased approximately 100 kips to 380 kips. Compressive stresses on the pile determined from the PDA were about 3500 psi which is well below the allowable driving stress of 5250 psi for this pile. The factor of safety for pile compressive capacity is estimated to be 1.9.

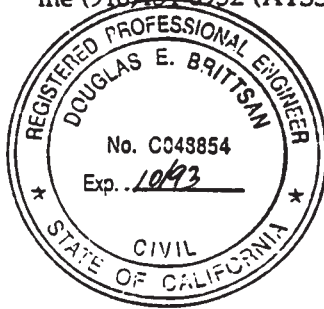
Conclusions

Although the factor of safety for pile compressive capacity is estimated at 1.9 rather than 2.0, as would be required for a static compressive load test, this value is, given the accuracy of pile dynamic monitoring equipment and techniques, sufficiently close to 2.0 as to warrant no corrective action. Furthermore, it is reasonable to expect additional pile set-up will occur beyond the one day allowed for in this test, thus providing a factor of safety for compressive pile capacity in excess of 2.0.

Measured compressive driving stresses were well below allowable levels. As such, no pile damage due to over stressing is suspected.

Mr. Wes Johnson
October 14, 1992
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If you have any questions regarding these load test results, please contact me (916)454-6952 (ATSS 497-6952).



A handwritten signature in cursive script that reads "Douglas E. Brittsan".

DOUGLAS E. BRITTSAN, P.E.
Transportation Civil Engineer
Office of Geotechnical Engineering

Attachments

cc:	RHPrysock-OGE (w/o attachments)	OEG-2 copies (w/attachments)
	Dan Speer-OGE	Ted Jensen-OSD
		Bridge Files-OEG
		Pile Test Files -OGE